UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P O Box 1450
Alexandria, Virginia 22313-1450
www uspto gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/811,460	03/26/2004	Regina I. Estkowski	RTN-208PUS	1782

33164 7590 04/30/2008
RAYTHEON COMPANY
C/O DALY, CROWLEY, MOFFORD & DURKEE, LLP
354A TURNPIKE STREET
SUITE 301A
CANTON, MA 02021

EXAMINER	
BEHNCKE, CHRISTINE M	
ART UNIT	**PAPER NUMBER**
3661	

MAIL DATE	DELIVERY MODE
04/30/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/811,460	Applicant(s) ESTKOWSKI ET AL.	
	Examiner CHRISTINE M. BEHNCKE	**Art Unit** 3661	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 February 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *12* is/are allowed.

6)☒ Claim(s) *1-11 and 13-27* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☒ Other: *3 Non patent literature references*.

DETAILED ACTION

This office action is in response to the Amendment and Remarks filed 2/8/2008, in which claims 1-27 were presented for examination.

Response to Arguments

Applicant's arguments with respect to claims 1-26 have been considered but are moot in view of the new grounds of rejection.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 1-11 and 13-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hocaoglu, Planning Multiple Paths with Evolutionary Speciation, in view of Thomaz, Mobile Robot Path Planning Using Genetic Algorithms.

Hocaoglu describes a method and system of planning at least one path for a vehicle in a state space from a starting position to a goal position to avoid a plurality of static or dynamic objects (figure 1) comprising: associating predetermined attributes with the plurality of static or dynamic objects located in the state space (figure 7), associating predetermined attributes with the plurality of static objects and/or the plurality of dynamic objects located in the state space, the state space being a probability space (figure 6); generating a probabilistic tree in the state space including a plurality of branches extending from the starting position of the vehicle towards the goal position located in the state space (figure 5); and extending the plurality of branches of the probabilistic tree

towards the goal position located in the state space based on a plurality of random tree extension rules (IV Evolutionary Evaluators) and a plurality of deterministic tree extension rules until satisfying a predetermined stopping condition (VI Evolutionary Path Planning algorithm, lines 32-55); and evaluating at least a first branch of the plurality of branches of the probabilistic tree for determining whether the first branch of the plurality of branches of the probabilistic tree satisfies predetermined trajectory path constraints (VI lines 32-55 and figure 6). Hocaoglu does not teach wherein the deterministic rules comprise linear paths and turning directions. However, Thomaz teaches using genetic algorithms, to determine a preferred robot path plan, wherein the probability tree comprises random tree extension rules (random genetic algorithms, Section 4, lines 1-6) and deterministic tree extension rules, the deterministic rules including adding a linear path (figure 3, straight line motion command) and extending the linear path by adding a turn such that at the end of the turn the vehicle is on a new heading that is closer to obtaining the goal position (Section 3, lines 55-64). It would have been obvious to one of ordinary skill, a high level ordinary skill in the robotic control art, to modify the invention of Hocaoglu with the teachings of Thomaz because Thomaz suggests a more detailed explanation of the implementation for the more generally described evolutionary path planning technique, described by Hocaoglu. It would further have been obvious to include the deterministic rules of using linear paths and turning to the goal as Thomaz suggests this allows for faster path computation (Section 1, lines 29-35).

(Claim 2) Hocaoglu further describes declaring the first branch of the plurality of branches of the probabilistic tree as the at least one preferred trajectory path for the vehicle in the state space (Section VI); and that it was well known in the art to use the path planning for controlling the vehicle (Section II, lines 122-127). Thomaz further teaches controlling a vehicle to follow the at least one preferred trajectory path in the state space for moving the vehicle from the starting position towards the goal position in the state space (figure 1, Section I). It would have been very obvious to one of ordinary skill in the robotic art to use the path planning computed by Hocaoglu and implement it with a mobile robot as taught by Thomaz.

(Claim 3) Hocaoglu further describes extending the plurality of branches of the probabilistic tree further based on the at least one of the plurality of random tree extension rules and the plurality of deterministic tree extension rules until at least one branch of the plurality of branches of the probabilistic tree satisfies the predetermined stopping condition and conforms to the predetermined trajectory path constraints (Section VI).

(Claims 4 and 5) Hocaoglu describes declaring the at least one branch of the plurality of branches of the probabilistic tree that couples the starting position to the goal position and that conforms to the predetermined trajectory path constraints as the at least one preferred trajectory path for the vehicle in the state space (figure 6); and repeating one or more of the previous steps at predetermined time intervals as the vehicle moves along the at least one preferred trajectory path toward the goal for updating the at least one preferred

trajectory path to compensate new positions of objects (Section VIII). Thomaz further teaches controlling a vehicle to follow the at least one preferred trajectory path in the state space for moving the vehicle from the starting position towards the goal position in the state space (figure 1, Section I). It would have been very obvious to one of ordinary skill in the robotic art to use the path planning computed by Hocaoglu and implement it with a mobile robot as taught by Thomaz.

(Claim 6) Hocaoglu further describes that it was known to satisfy the predetermined stopping condition by at least one of satisfying a predetermined time constraint and satisfying a predetermined travel distance constraint (Section VI and Table III).

(Claim 7) Hocaoglu further describes wherein associating predetermined attributes with the plurality of static objects and/or the plurality of dynamic objects located in the state space includes associating at least one of a position value, a velocity value, a direction value, an acceleration value and a time value (Section II, lines 122-127).

(Claims 8-11) Hocaoglu further describes wherein generating the probabilistic tree in the state space further includes extending edges between nodes based on a plurality of random tree extension rules and the plurality of deterministic tree extension rules for forming first segments of each of the plurality of branches of the probabilistic tree (Section II, 49-79). Hocaoglu does not describe that the edges are extended a predetermined distance and direction from the starting position and further cycling thru the algorithm until a termination

condition is reached (Section III).Hocaoglu further shows that the branch is evaluated if it reaches an object, and stops the expansion of that branch if it does reach an object (Section II, lines 41-79, figure 12). However, Thomaz teaches the implementation of the path planning, wherein the extension of each of a first plurality of edges a first predetermined distance and direction from the starting position in the state space (Figure 3, section 3).Thomaz further describes where in the distance and direction are iterated for corresponding next nodes to create the successive branches of the tree (Figure 3, section 3) until a termination condition is reached. It would have been obvious to one of ordinary skill to modify the invention of Hocaoglu with the teachings of Thomaz because as Thomaz suggests, restricting the iteration distances and direction allows for less random searching and quicker solution to the goal (Section 3, lines 55-69).

(Claim 13) Hocaoglu further describes extending the tree branches based on random tree extension rules includes at least one of extending each branch into the state space that is void of the plurality of static objects and the plurality of dynamic objects and extending each branch into the state space that is void of other branches of the plurality of branches of the probabilistic tree (Section VI, path algorithm).

(Claims 14 and 15) Hocaoglu does not teach wherein the deterministic rules comprise linear paths and turning directions. However, Thomaz teaches the deterministic rules including adding a linear path such that a heading is constant (figure 3, straight line motion command). Thomaz further teaches whether the first branch of the plurality of branches of the probabilistic tree satisfies the

predetermined trajectory path constraints includes determining whether the first branch of the plurality of branches of the probabilistic tree satisfies at least one of a maximum travel distance value, a maximum turn angle value, a minimum distance value to the plurality of static objects and the plurality of dynamic objects (). Thomaz does not explicitly describe that during the linear movement the speed is constant, however this would be very obvious to one of ordinary skill in the art to hold the speed constant as this would simplify the fitness function used by Thomaz, by at least one variable (Section 3, lines 55-69).

(Claim 16) Hocaoglu describes a path planning method for a vehicle, comprising: defining a state space including an initial start position and a goal position, the state space being a probability space (figure 1); generating a plurality of paths from the start position to the goal position over time on a node by node basis based upon a set of rules (figure 5, Section IV, Section II, lines 41-60) comprising deterministic rules, randomness rules and a probabilistic rules (Section IV and Section VI); assigning locations to objects in the state space over time based upon respective probability distributions (Section II, lines 122-127); and selecting a first one of the generated plurality of paths (figure 11). Hocaoglu does not teach wherein the deterministic rules comprise linear paths and turning directions. However, Thomaz teaches using genetic algorithms, to determine a preferred robot path plan, wherein the probability tree comprises random tree extension rules (random genetic algorithms, Section 4, lines 1-6) and deterministic tree extension rules, the deterministic rules including adding a linear path such that a heading is constant (figure 3, straight line motion command) and

extending the linear path by adding a turn such that at the end of the turn the vehicle is on a new heading that is closer to obtaining the goal position (Section 3, lines 55-64). Thomaz does not explicitly describe that during the linear movement the speed is constant, however this would be very obvious to one of ordinary skill in the art to hold the speed constant as this would simplify the fitness function used by Thomaz, by at least one variable (Section 3, lines 55-69). It would have been obvious to one of ordinary skill, the ordinary skill being a high level of skill in the robotic control art, to modify the invention of Hocaoglu with the teachings of Thomaz because to include the deterministic rules of using linear paths and turning to the goal as Thomas suggests this allows for faster path computation (Section 1, lines 29-35).

(Claims 17-21) Hocaoglu further describes including terminating ones of the plurality of paths that are not feasible at a given node in the state space (figure 12); terminating paths based upon one or more of impact with an object, region avoidance, g-force limitations, sensor information, path distance, path time, number of turns, altitude change limitations, straight path desirability, object location confidence level, turning radius limitations, and turning penalties (Section VI); assigning a confidence level to object locations (Section II, lines 122-127); assigning object state information including one or more of position, heading, velocity, acceleration, turning radius, acceleration limit, velocity limit, g-force limit, and location confidence level (Section II, lines 122-127); and assigning a probability distribution to one or more components of the object state information (Section II, lines 122-127).

(Claims 22, 24 and 27) Hocaoglu describes a method and system of adaptive path planning for a vehicle, comprising: defining a state space for the vehicle and a plurality of objects, the state space being a probability space (figure 1, Section II, lines 29-60); setting a root node to initial state for the vehicle (starting node, figure 5); generating a plurality of paths comprising node-to-node branches from a vehicle start location to a goal location, each node being a probability distribution (figure 2 and figure 4, Section II, lines 29-60); examining each of the branches to determine whether stopping conditions are satisfied (Section VI, algorithm step 3); generating first ones of the branches using deterministic extension rules (Section VI, lines 32-55); generating second ones of the branches using random extension rules (Section IV); determining whether first ones of the plurality of branches should terminated (figure 2); and selecting a first one of the plurality of paths that extend to the goal location (figure 6). Hocaoglu does not teach wherein the deterministic rules comprise linear paths and turning directions. However, Thomaz teaches using genetic algorithms, to determine a preferred robot path plan, wherein the probability tree comprises random tree extension rules (random genetic algorithms, Section 4, lines 1-6) and deterministic tree extension rules, the deterministic rules including adding a linear path such that a heading is constant (figure 3, straight line motion command) and extending the linear path by adding a turn such that at the end of the turn the vehicle is on a new heading that is closer to obtaining the goal position (Section 3, lines 55-64). Thomaz does not explicitly describe that during the linear movement the speed is constant, however this would be very obvious

to one of ordinary skill in the art to hold the speed constant as this would simplify the fitness function used by Thomaz, by at least one variable (Section 3, lines 55-69). It would have been obvious to one of ordinary skill, the ordinary skill being a high level of skill in the robotic control art, to modify the invention of Hocaoglu with the teachings of Thomaz because to include the deterministic rules of using linear paths and turning to the goal as Thomas suggests this allows for faster path computation (Section 1, lines 29-35).

(Claims 23 and 25) Hocaoglu further describes assigning state information to the plurality of objects including one or more of position, heading, velocity, acceleration, turning radius, acceleration limit, velocity limit, g-force limit, and location confidence level (Section II, lines 122-127).

(Claim 26) Hocaoglu describes the path planning was well known to have been conducted off-line then loaded to a robot for implementation (Section II, lines 104-115).

Allowable Subject Matter

Claim 12 is allowed.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is

filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTINE M. BEHNCKE whose telephone number is (571)272-8103. The examiner can normally be reached on 8:30 am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Thomas G. Black can be reached on (571) 272-6956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CMB

/Thomas G. Black/
Supervisory Patent Examiner, Art Unit 3661